

Applicant: Sakari Solni
Application No.: 10/089,800
Art Unit: 1731

Claim Listing

1-11. (cancelled)

12. (currently amended) The method of claim ~~11~~ 31, wherein the elements generating and maintaining turbulence comprise stepped expansions of the flow cross-section area of the turbulence pipes, the stepped expansions being positioned in superimposed rows of the turbulence pipes at different distances from the slice opening of the headbox.

13. (currently amended) The method of claim ~~11~~ 31, wherein the turbulence pipes have outlet ends through which the stock suspension flow passes into the slice duct, and wherein the elements generating and maintaining turbulence comprise trailing elements on the outlet ends of the turbulence pipes, the trailing elements extending to the slice duct of the headbox, wherein each trailing element has a tip, and wherein the distance of the tips from the slice opening of the headbox is arranged to be different between the superimposed flow layers.

14. (cancelled)

15. (cancelled)

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16. (currently amended) The turbulence generator of claim 15-17, further comprising:
a plurality of trailing elements connected to the turbulence generator, starting from between
the pipe rows and extending towards the slice duct of the headbox, each trailing
element having a tip at its downstream end; and
wherein in superimposed pipe rows, the distance of the tips of the trailing elements from the
slice opening of the headbox in association with the pipe rows, is different in that at
the slice opening a different turbulence prevails in different layers of the stock
suspension flow.

17. (currently amended) A turbulence generator in a headbox of a paper machine, the
headbox having a width, and a slice opening, the turbulence generator comprising:
a plurality of superimposed turbulence pipes arranged in rows extending across the entire
width of the headbox, through which a stock suspension flow to be conducted from
the headbox through the slice opening to a web former is arranged to flow; and
portions of each turbulence pipe which define a stepped expansion of the flow cross-section
area in the space between an inlet end and an outlet end of each pipe, the stepped
expansion of each turbulence pipe being positioned at an expansion spot, wherein in
superimposed pipe rows, the distance of the expansion spot of the turbulence pipes
from the slice opening of the headbox in association with the pipe rows, is different
in that at the slice opening, in the headbox, a different turbulence prevails in different
layers of the stock suspension flow; and The turbulence generator of claim 15,
wherein the superimposed rows of turbulence pipes include a centermost row of pipes, and
wherein the expansion spots of the pipes within a row are positioned closer to the
slice opening of the headbox, the closer said pipe row is to the centermost pipe
row.

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18. (currently amended) A turbulence generator in a headbox of a paper machine, the headbox having a width, and a slice opening, the turbulence generator comprising:
a plurality of superimposed turbulence pipes arranged in rows extending across the entire width of the headbox, through which a stock suspension flow to be conducted from the headbox through the slice opening to a web former is arranged to flow; and
portions of each turbulence pipe which define a stepped expansion of the flow cross-section area in the space between an inlet end and an outlet end of each pipe, the stepped expansion of each turbulence pipe being positioned at an expansion spot, wherein in superimposed pipe rows, the distance of the expansion spot of the turbulence pipes from the slice opening of the headbox in association with the pipe rows, is different in that at the slice opening, in the headbox, a different turbulence prevails in different layers of the stock suspension flow; and The turbulence generator of claim 15,
wherein the superimposed rows of turbulence pipes include a lowermost row of pipes, and wherein the expansion spots in a row are closer to the slice opening of the headbox, the farther said pipe row is from the lowermost pipe row of the turbulence generator.

19-20. (cancelled)

21. (currently amended) The turbulence generator of claim 20 ~~31~~, wherein the flow cross-section areas of the turbulence pipes of one of the superimposed pipe rows are greater, the closer said pipe row is to a centermost pipe row of the turbulence generator.

22-24. (Cancelled)

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25. (currently amended) The paper machine headbox apparatus of claim 24 26 further comprising a plurality of trailing elements, each trailing element starting from between two turbulence pipe rows and extending towards the slice duct of the headbox, each trailing element having a tip at its downstream end; and the distance of the tips of the trailing elements from the slice opening of the headbox is not the same for all trailing elements.

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26. (currently amended) A paper machine headbox apparatus having a width comprising:
- a first row of a plurality of turbulence pipes extending across the entire width of the headbox;
 - a second row of turbulence pipes extending across the entire width of the headbox, and positioned below the first row;
 - a third row of turbulence pipes extending across the entire width of the headbox, and below the second row, wherein each turbulence pipe is comprised of an initial section of a first cross-sectional area, and an end section downstream of the initial section, the initial section being connected to the end section at a stepwise expansion point, at which the cross-sectional area increases, and
 - a slice duct positioned to receive stock suspension flow from the turbulence pipes and discharging through a slice opening to a web former, wherein the stock suspension flow is distributed into a plurality of layers by the rows of turbulence pipes, turbulence being generated in different layers of the flow in different phases of the flow by the stepwise expansion points, the spacing of the stepwise expansion points from the slice opening being different depending on the row in which a particular turbulence pipe is located, and the head box is structured and arranged so that at the slice opening, a different turbulence prevails in different layers of the stock suspension flow; and The turbulence generator of claim 24;
- wherein the second row of turbulence pipes is the centermost row, and wherein the expansion spots of the turbulence pipes within a row are positioned closer to the slice opening of the headbox, the closer said pipe row is to the centermost pipe row.

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27. (currently amended) A paper machine headbox apparatus having a width comprising:

a first row of a plurality of turbulence pipes extending across the entire width of the headbox;

a second row of turbulence pipes extending across the entire width of the headbox, and positioned below the first row;

a third row of turbulence pipes extending across the entire width of the headbox, and below the second row, wherein each turbulence pipe is comprised of an initial section of a first cross-sectional area, and an end section downstream of the initial section, the initial section being connected to the end section at a stepwise expansion point, at which the cross-sectional area increases;

a slice duct positioned to receive stock suspension flow from the turbulence pipes and discharging through a slice opening to a web former, wherein the stock suspension flow is distributed into a plurality of layers by the rows of turbulence pipes, turbulence being generated in different layers of the flow in different phases of the flow by the stepwise expansion points, the spacing of the stepwise expansion points from the slice opening being different depending on the row in which a particular turbulence pipe is located, and the headbox is structured and arranged so that at the slice opening, a different turbulence prevails in different layers of the stock suspension flow; and The turbulence generator of claim 24;

wherein the third row of turbulence pipes is a lowermost row, and wherein the expansion spots in a row are closer to the slice opening of the headbox, the farther said pipe row is from the lowermost pipe row of the turbulence generator.

28. (cancelled)

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29. (currently amended) A paper machine headbox apparatus comprising:
a first row of turbulence pipes;
a second row of turbulence pipes below the first row;
a third row of turbulence pipes below the second row, wherein each turbulence pipe is
comprised of an initial section of a first cross-sectional area, and an end section
downstream of the initial section, the initial section being connected to the end
section at a stepwise expansion point, at which the cross-sectional area increases;
a plurality of trailing elements, each trailing element starting from between two turbulence
pipe rows and extending towards the slice duct of the headbox, each trailing
element having a tip at its downstream end, and the distance of the tips of the trailing
elements from the slice opening of the headbox is not the same for all trailing
elements; and
a slice duct positioned to receive stock suspension flow from the turbulence pipes and
discharging through a slice opening to a web former, wherein the stock suspension
flow is distributed into a plurality of layers by the rows of turbulence pipes,
turbulence being generated in different layers of the flow in different phases of the
flow by the stepwise expansion points and the trailing elements, and the headbox is
structured and arranged so that at the slice opening, a different turbulence prevails in
different layers of the stock suspension; and The turbulence generator of claim 28;
wherein the second row of turbulence pipes is the centermost row, and wherein the cross-sectional areas after the stepwise expansion points of the turbulence pipes of the first row and the third row are less than the cross-sectional areas after the stepwise expansion points of the centermost row.

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30. (currently amended) A paper machine headbox apparatus comprising:
a first row of turbulence pipes;
a second row of turbulence pipes below the first row;
a third row of turbulence pipes below the second row, wherein each turbulence pipe is
comprised of an initial section of a first cross-sectional area, and an end section
downstream of the initial section, the initial section being connected to the end
section at a stepwise expansion point, at which the cross-sectional area increases;
a plurality of trailing elements, each trailing element starting from between two turbulence
pipe rows and extending towards the slice duct of the headbox, each trailing
element having a tip at its downstream end, and the distance of the tips of the trailing
elements from the slice opening of the headbox is not the same for all trailing
elements; and
a slice duct positioned to receive stock suspension flow from the turbulence pipes and
discharging through a slice opening to a web former, wherein the stock suspension
flow is distributed into a plurality of layers by the rows of turbulence pipes,
turbulence being generated in different layers of the flow in different phases of the
flow by the stepwise expansion points and the trailing elements, and the headbox is
structured and arranged so that at the slice opening, a different turbulence prevails in
different layers of the stock suspension; and The turbulence generator of claim 28;
wherein the third row of turbulence pipes is the lowermost row, and wherein the cross-sectional areas after the stepwise expansion points of the turbulence pipes of the second row are greater than the cross-sectional areas after the stepwise expansion points of the lowermost row, and the cross-sectional areas after the stepwise expansion points of the first row are greater than the cross-sectional areas after the stepwise expansion points of the second row.

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31. (new) A method for forming a paper web employing a headbox comprising the steps of:

generating and maintaining turbulence in a stock suspension flow which is conducted through a turbulence generator into a slice duct of the headbox and from the slice duct through a slice opening to a web former;

wherein the stock suspension flow is distributed into a number of superimposed layers of the varying turbulence generated with the aid of turbulence pipes, each pipe having an element for generating and maintaining turbulence, and all the layers flowing together within the headbox before the slice opening;

wherein the superimposed layers include at least one layer which is filtered first by the web former and at least one layer which is filtered last by the web former;

wherein the turbulence generated in the different layers of the flow are made different by arranging the elements generating and maintaining turbulence at different distances from the slice opening; and

wherein the elements generating and maintaining turbulence are arranged so that those elements generating the layer(s) of stock suspension being filtered last in the web former are positioned closer to the slice opening of the headbox, than the elements generating the layer(s) being filtered first.

32. (new) The method of claim 31 wherein the web former is a gap former and wherein the superimposed layers include an uppermost layer and a lowermost layer which are filtered first.

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33. (new) The method of claim 31 wherein the web former is a Fourdrinier or hybrid former and wherein the superimposed layers include a lowermost layer which is filtered first and a plurality of upper layers which are filtered sequentially, and wherein the elements generating and maintaining turbulence in the upper layers are arranged progressively closer to the slice opening.

34. (new) A paper machine headbox comprising:
a headbox having a width, and a slice opening;
a plurality of superimposed turbulence pipes, each pipe having an inlet and an outlet end, the superimposed turbulence pipes arranged in rows extending across the entire width of the headbox, which are arranged so that a stock suspension will flow through the turbulence pipes and into a slice and through the slice opening to a web former having at least one wire;
a plurality of trailing elements fastened as continuations to the pipe rows and extending into the slice and toward the slice opening, each trailing element having a downstream end defined by a tip;
portions of each turbulence pipe which define a stepped expansion of the flow cross-section area between the inlet and the outlet end of each pipe, the stepped expansion of each turbulence pipe defining an expansion spot;
wherein in the plurality of trailing elements, the length of the trailing elements from the pipe rows to the tip of the trailing element differ in length; and
wherein the turbulence pipes of superimposed pipe rows have different and greater flow cross-section areas where the rows are more distant from the at least one wire.

35. (new) The papermaking machine of claim 34 wherein the web former having two wires and the turbulence pipes of the superimposed pipe rows have greater flow cross-section areas where the rows are more distance from both wires.